



## Mechanics/Machinery

### Stacked Corrugated Horn Rings

*NASA's Jet Propulsion Laboratory, Pasadena, California*

This Brief describes a method of machining and assembly when the depth of corrugations far exceeds the width and conventional machining is not practical. The horn is divided into easily machined, individual rings with shoulders to control the depth. In this specific instance, each of the corrugations is identical in profile, and only differs in diameter and outer profile. The horn is segmented into rings

that are cut with an interference fit (zero clearance with all machining errors biased toward contact). The interference faces can be cut with a reverse taper to increase the holding strength of the joint. The taper is a compromise between the interference fit and the clearance of the two faces during assembly.

Each internal ring is dipped in liquid nitrogen, then nested in the previous,

larger ring. The ring is rotated in the nest until the temperature of the two parts equalizes and the pieces lock together. The resulting assay is stable, strong, and has an internal finish that cannot be achieved through other methods.

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### Refinements in an Mg/MgH<sub>2</sub>/H<sub>2</sub>O-Based Hydrogen Generator

**Externally generated steam would be needed only briefly to start operation.**

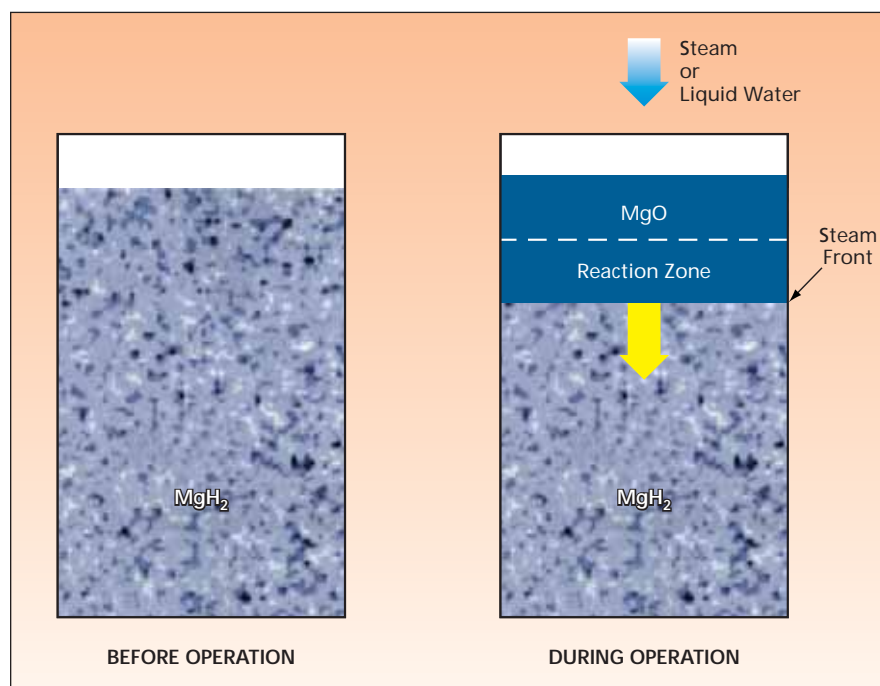
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Some refinements have been conceived for a proposed apparatus that would generate hydrogen (for use in a fuel cell) by means of chemical reactions among magnesium, magnesium hydride, and steam. The refinements lie in tailoring spatial and temporal distributions of steam and liquid water so as to obtain greater overall energy-storage or energy-generation efficiency than would otherwise be possible.

A description of the prior art is prerequisite to a meaningful description of the present refinements. The hydrogen-generating apparatus in question is one of two versions of what was called the "advanced hydrogen generator" in "Fuel-Cell Power Systems Incorporating Mg-Based H<sub>2</sub> Generators" (NPO-43554), *NASA Tech Briefs*, Vol. 33, No. 1 (January 2009), page 52. To recapitulate: The apparatus would include a reactor vessel that would be initially charged with magnesium hydride. The apparatus would exploit two reactions:

- The endothermic decomposition reaction  $\text{MgH}_2 \rightarrow \text{Mg} + \text{H}_2$ , which occurs at a temperature  $\geq 300^\circ\text{C}$ , and
- The exothermic oxidation reaction  $\text{MgH}_2 + \text{H}_2\text{O} \rightarrow \text{MgO} + 2\text{H}_2$ , which occurs at a temperature  $\geq 330^\circ\text{C}$ .

Once the initial heating was complete and both reactions under way, the endothermic reaction would be sustained by the heat generated from the exothermic reaction. For every mole of MgH<sub>2</sub> oxidized, sufficient waste heat is



Water Would Be Injected at one end of a reactor bed containing MgH<sub>2</sub> particles. Initially, the water would be in the form of steam as needed to start the reactions. Thereafter, liquid water would be injected, and one of the reactions, which is exothermic, would supply the necessary heat.

generated to decompose an additional three moles of the hydride. As a consequence of these reaction ratios, the major reaction product is Mg, and the minor one MgO. Both have extremely low toxicity. MgH<sub>2</sub> is easily recycled to Mg. In theory, no energy is required because regeneration produces enough

heat to power the process. A practical system would not be 100-percent efficient so it would be expected that there would be a modest energy cost. The MgO can be safely and easily recycled in a magnesium-refining plant for less than the cost of smelting Mg because MgO is an intermediate product of that